



Mobile PCs and Wireless:

Business Users Make the
Productivity Connection

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Executive Summary

Business demand for wireless connectivity is growing dramatically worldwide, driven by the expanding ranks of enthusiastic mobile PC users and reinforced by increasingly confident IT departments. Mobile PC users with wireless access to information – anywhere, anytime – are substantially more productive and efficient than their wired colleagues.¹ Recent studies have also documented increased job satisfaction tied directly to the greater convenience and flexibility enabled by notebooks and wireless access.²

IT departments are encouraged by more established wireless standards, improved security and better integration of wireless with mobile PCs. Furthermore, the Total Cost of Ownership for both mobile and wireless solutions is steadily decreasing. As a result, many IT groups are aggressively deploying mobile PCs and wireless networks within their organizations.

To fully leverage the advantages of wireless access, business users need thin and light notebooks for maximum mobility, high performance to run e-Business applications including security applications, and long battery life to work anytime, anywhere. Intel® Mobile Technology delivers on these business user needs by enabling mobile PCs with high performance and long battery life in a variety of form factors.

This paper will review current trends in the business use of wireless networking. It will describe the

primary technology standards and show how corporations use different types of wireless connectivity to drive business productivity. Finally, it will show how recent advancements in Intel Mobile Technology enable business users and IT managers to utilize wireless effectively and profitably for their businesses.

Current Trends in Business Wireless

Business Productivity Rises with Wireless Access

Two recent studies have concluded that business users with mobile PCs and wireless connectivity are substantially more productive than colleagues who use similar systems with wired connectivity. A 2001 Sage Research* report based on interviews with twenty large North American companies found employees realized an additional eight hours per week of productivity when using mobile PCs and a corporate wireless LAN.³ Similarly, Gartner Consulting* reports that, "Professional wireless users with notebooks who spend 20% or more the time out of the office reported 41% higher productivity gains and efficiency savings than wired professionals with notebooks." Gartner estimates the time value of this gain at 7.5 additional hours per user, per week.⁴

More Businesses are Deploying Wireless

The convenience of wireless connectivity as a flexible extension of wired networks and the high ROI associated with wireless access are driving rapid adoption of wireless

connectivity by corporations. Gartner Dataquest* estimates that the worldwide WLAN market value will reach \$1.7 billion in 2002, and that WLAN adapter shipments will total 9 million units this year.⁵ Other significant factors accelerating wireless deployment are higher data rates, improved security, standardization and lower costs.

VPN Technology Ensures Robust Wireless Security

Commonly known as VPN, virtual private network technology enables secure client-server connections over the Internet in both wired and wireless environments. It works by establishing one-to-one secure connections between clients and a VPN gateway, which in the case of an 802.11b network sits just behind the wireless access point. Packets traveling from one client to another over a wireless network pass first through the sending client's VPN tunnel, past the access point and out through the VPN gateway. The packets then travel over the wired local network to another VPN gateway, where they are encrypted before being transmitted to the receiving client via a wireless access point. VPN applies authentication and encryption mechanisms that have proven extremely durable over the past several years. By placing a VPN gateway behind the 802.11b access point, companies can ensure that all wireless transmissions are thoroughly protected.

Total Cost of Ownership (TCO) is Decreasing

The cost of WLAN implementation is dropping steadily. Sara Harris, a senior industry analyst in Strategy Analytics Global Wireless Practice, sees many reasons behind the success of 802.11b. "Wireless LANs offer businesses flexibility on a scale that is just not possible with wired alternatives," Harris says. "Costs are coming down, speeds are going up and the performance gap between wireless and hard-wired LANs is narrowing." Factors such as lower installation costs, simple workspace reconfiguration, and the elimination of stranded cabling costs decrease TCO and make wireless an appealing option.

And the same trends are apparent in mobile PC costs. The Total Cost of Ownership associated with a mobile PC declined almost 30% between 1998 and 2001⁶, making it more affordable than ever to provide mobile systems and wireless connectivity to corporate users.

Three Types of Wireless Networks

PANs, WLANs and WWANs: Different Types of Wireless Networks

Wireless networking technologies are commonly grouped into three types based on the effective operating range of their radio systems. Businesses use personal, local and wide area wireless networks (PANs, WLANs and WWANs) to drive business productivity.

Personal Area Networks (PANs) are short-range (up to 10 meters) links that connect an individual user's computing and communication tools – including a notebook PC, PDA, mobile phone or printer. Short-range wireless solutions simplify data synchronization, eliminate connecting cables between devices, and enable ad hoc file exchange between individuals and among small groups. The primary standard for personal area networking is Bluetooth* Wireless Technology.

Wireless Local Area Networks (WLANs) are medium-range (up to 100 meters) links that connect groups of users and their shared resources within an organization's building or campus. In large companies, WLANs are typically used to extend the reach of a conventional wired LAN. In some small firms, a WLAN may eliminate most wired connections altogether. The major standard for WLAN networks is 802.11.

Wireless Wide Area Networks (WWANs) are long-range wireless links that connect mobile users to corporate networks and the Internet over public cellular voice networks. Because the evolution of these networks as practical media for data transfer is still very much in progress, no single technology dominates the category. But the General Packet Radio Service (GPRS) currently being deployed on GSM digital voice networks is a high-rate wireless data solution that is widely available in Europe, and is currently being implemented by national carriers in the U.S.

Standard Technologies for Wireless Networking

Bluetooth* Wireless Technology for Personal Area Networks

Bluetooth Wireless Technology is a global open specification for low-power, low-cost, radio-based links between personal computing and productivity tools. Bluetooth client devices connect with each other directly at distances of up to 10 meters, using a highly secure and reliable radio system⁷ that provides data transfer rates of up to 1Mbps. This bandwidth is shared among up to seven simultaneously connected devices, which may include Bluetooth-enabled mobile PCs, mobile phones, PDAs and printers.

Productivity Benefits of Bluetooth Wireless Technology

Business users with Bluetooth connectivity can quickly and easily transfer information between their mobile PC and other personal devices, leading to enhanced productivity and efficiency. Examples include:

- Mobile Internet access from a notebook PC, using a Bluetooth-compliant wireless phone as a modem.
- Wireless printing from a Bluetooth-enabled notebook PC and printer.
- Cable-free file transfer and data synchronization (business cards, documents, calendar appointments, etc.) between

*Bluetooth is a trademark owned by its proprietor and used by Intel Corporation under license.

individuals and workgroups using Bluetooth-enabled notebooks and PDAs.

- Wireless backup between a Bluetooth-enabled notebook PC and desktop.

802.11 Technologies for Wireless Local Area Networks

The 802.11 family of specifications for Ethernet-based WLANs was developed by the Institute of Electrical and Electronics Engineers (IEEE), and adopted by the Wireless Ethernet Compatibility Alliance (WECA), an international association of equipment manufacturers that tests and certifies products for reliable interoperability. The 802.11b specification, approved in 1999, offered the first effective solution for high-speed wireless networking in the enterprise, with data rates of up to 11Mbps and a range of up to 100 meters delivered through an air interface operating in the 2.4GHz spectrum. The 802.11b standard is now approved for use in most of North America, Europe and Asia, stimulating the first large-scale adoption of WLANs.

Productivity Benefits of 802.11 WLAN Connectivity

Large organizations use WLANs to connect mobile workers, provide information access in common work and meeting areas, and to extend the corporate network into areas where wired connections are impractical or uneconomical. Smaller organizations may dispense with a wired LAN entirely and deploy a WLAN as a standalone

infrastructure. All business users with 802.11 connectivity can easily communicate and access their information anytime, anywhere, leading to enhanced productivity and efficiency. Examples include:

- Professionals can access time-sensitive, business-critical content anytime, anywhere and thus make faster decisions.
- Virtual teams can communicate seamlessly with colleagues via face-to-face video conferencing.
- Account Executives can improve customer service by accelerating response time and resolution.

Creating an 802.11 WLAN

Setting up an 802.11 WLAN requires that all client computers and peripherals be equipped with an appropriate adapter. This is typically a NIC or PCMCIA card, although some mobile PCs can now be ordered with integrated WLAN capability. In addition, at least one access point must be connected to the WLAN, or to the WAN gateway in the case of a standalone WLAN. Each access point will have an approximate range of 100 meters/300 feet and will support up to 150 users.

Other Wireless LAN Standards

While current deployments are focused on the proven 802.11b standard, an additional specification has been approved that will provide higher speeds and greater transfer rates. 802.11a enables up to 54Mbps transfer capacity on the stable 5GHz spectrum. Although 802.11a is not reverse compliant

with existing 802.11b networks, dual 802.11a/b PCMCIA cards will be available in 2002.

Cellular Solutions for Wide Area Wireless Connectivity

For frequent travelers who are often away from the office LAN, cellular voice networks offer a growing range of data services for remote access to corporate networks, e-mail, the Internet and other resources. Until recently, these services were limited to the relatively slow transfer rates available on first-generation analog and second-generation (2G) digital networks. But service providers worldwide are rapidly deploying faster next-generation (2.5G) services as part of a staged evolution to high-speed, third-generation (3G) networks. For example, WCDMA, a 3G digital network, was introduced in Japan in 2001. The chart on the following page identifies the primary wide area wireless standards currently or soon to be available, along with their approximate data transfer rates.

Productivity Benefits of Wireless Wide Area Connectivity

A wireless wide area connection is the mobile user's key to eliminating forced downtime and seizing opportunity whenever and wherever it appears. The tasks that can be accomplished on a WWAN-enabled notebook PC depend largely on the connection's data transfer capacity. 10Kbps supports basic e-mail and light Web access. 100Kbps provides ample bandwidth for on-line multimedia, videoconferencing and remote access to enterprise systems.

2.4Mbps, when it becomes available, will deliver access speed and performance approaching those of a LAN, and will support even computation-intensive functions like remote design collaboration and fast media file transfer. User productivity soars with the ability to bring information and analysis to bear from any location, at any time. Opportunities to drive productivity abound.

- An executive can download the latest sales figures in a taxi, and incorporate them into a presentation en route to a meeting.
- A service engineer can send photos of damaged equipment and download CAD drawings for a field repair on site at a distant customer location.
- The district manager for a national retailer can retrieve real-time inventory and point-of-sale figures from a corporate data warehouse, and upload revised demand forecasts, while traveling between stores in his territory.

Creating a Wireless Wide Area Connection

Notebook PCs can be WWAN enabled for most currently available services by adding an appropriate PCMCIA card and software, or through a cable connection to a mobile phone. Another possibility is to use a Bluetooth PC card to connect the mobile PC with a Bluetooth-enabled cellular phone.

Intel® Mobile Technology Advantages

Today's business PC users are constantly in motion and continuously connected, their productivity fueled by data streams that are growing exponentially. These always-on workstyles and the rising productivity they make possible require mobile computing systems that make no compromises in either performance or portability.

High Performance is a Prerequisite

High-performance mobile CPUs are an essential tool for today's wireless business users. Their notebook PC routinely runs computation-intensive programs like customer relations management (CRM) software in the foreground while running important security applications such as Virtual Private Networks (VPNs), encryption and authentication in the background. E-mail messages with large attachments and presentations with embedded audio and video make multi-megabit files the norm, not the exception. New operating systems like Windows® XP support a wider range of communications possibilities, like instant video messaging, and XML-based data exchange makes legacy systems accessible from anywhere, at anytime. All these advances add to the mobile user's potential productivity, if he or she has the processing power to take advantage of them.

Standard		Max. Data Rate	Generation
TDMA	Time Division Multiple Access	9.6Kbps	2G
GSM	Global System for Mobile Communication	9.6Kbps	2G
CDPD	Cellular Digital Packet Data	19.2Kbps	2G
CDMA	Code Division Multiple Access	14.4Kbps	2G
CDMA 2000 1X		114Kbps	2.5G
GPRS	General Packet Radio Service	115Kbps	2.5G
EDGE	Enhanced Data Rates for Global Evolution	384Kbps	2.5G
CDMA 2000		2.4Mbps	3G
WCDMA	Wideband Code Division Multiple Access	2.4Mbps	3G

The availability of all services varies geographically, so wise travelers will consult providers in frequently visited destinations as well as in their local service areas.

Intel® Mobile Technology helps meet these performance demands with headroom to spare. The Mobile Intel® Pentium® 4 Processor - M is the fastest Intel mobile processor on the market. Featuring Intel® NetBurst™ microarchitecture, the Mobile Intel Pentium 4 Processor - M provides the battery life and performance you need for demanding wireless connectivity and security applications.

In SysMark* 2001 benchmarks for user productivity, the Mobile Intel Pentium 4 Processor - M at 1.7 GHz scored 45 percent higher than the Mobile Intel® Pentium® III Processor - M at 1.0 GHz.⁸

Thinner, Lighter Systems

The Mobile Intel Pentium 4 Processor - M and the Mobile Intel Pentium III Processor - M are both available in small form factor packaging that consumes less internal space, allowing system manufacturers to provide high performance in thinner, lighter designs. The Mobile Intel Pentium 4 Processor - M is available in thin and light, and full-size systems. The Mobile Intel Pentium III Processor - M is available in all form factors, including mini and subnotebooks.

Extended Battery Life

Notebook PCs with Intel Mobile Technology extend battery life for longer work sessions between recharges. Enhanced Intel® SpeedStep™ Technology helps to optimize application performance and power consumption, Deeper

Sleep Alert State, a dynamic power management mode, adjusts voltage during brief periods of inactivity – including micro-seconds between key strokes – for longer battery life.

The long battery life of notebooks using the Mobile Intel Pentium 4 Processor - M and the Mobile Intel Pentium III Processor - M provides mobile users the ability to work extended periods of time while away from their desk. For example, the Mobile Intel Pentium III Processor - M consumes up to one-third less power than a conventional Intel® Pentium III Processor of equal core speed.

Mobility, Connectivity, Productivity

The dramatic growth in business demand for wireless connectivity is a direct result of the natural synergy between wireless access, mobile PCs and new data-driven workstyles. Multiple studies confirm productivity gains of between 7 and 8 hours a week when business users are equipped with mobile PCs and wireless access. Companies of all sizes are moving aggressively to realize these advantages with new wireless infrastructure investments that enable anytime, anywhere connectivity at the personal, local and wide area network levels. IT departments have become active proponents of these developments, won over by robust VPN security and the decreasing Total Cost of Ownership for new mobile PCs.

When choosing notebook PCs that will energize the productivity of mobile workers, the factors that enable complete exploitation of wireless connectivity are high performance; thin, light form factors; and long battery life. The Mobile Intel® Pentium® 4 Processor - M extends Intel's long history of innovation and leadership in these critical aspects of mobile computing and communications. Notebook PCs built on the Mobile Intel Pentium 4 Processor - M platform will give your users the power to seize opportunity wherever and whenever they find it.

For more information:

www.intel.com/ebusiness/mobile

¹ According to research by Gartner Consulting, "The Benefits and TCO of Notebook Computing," Mobile PC business users with wireless are 41% more productive compared to similar mobile PC business users with wired connectivity.

² "Wireless LAN: Increased Productivity and Employee Satisfaction."

³ "Wireless LANs: Improving Productivity and Quality of Life." Published by Sage Research 2001. Available at http://www.intel.com/ebusiness/products/related_mobile/wp012603_sum.htm

⁴ "Benefits and TCO of Notebook Computing," Gartner Consulting, May 2001. These interview-based results may differ from Gartner's published positions.

⁵ Reported in Network Computing Survivor's Guide to Mobile and Wireless Technology 2002 <http://www.nwc.com/1226/1226f4.html>

⁶ "Benefits and TCO of Notebook Computing," Gartner Consulting, May 2001. These interview-based results may differ from Gartner's published positions.

⁷ The Bluetooth radio interface is a frequency-hopping spread spectrum design that operates in the 2.4GHz frequency band. Because the radio transmission shifts rapidly between narrow slices of spectrum, the signal is both difficult to intercept and relatively resistant to interference.

⁸ For more information about the high performance of the Mobile Intel® Pentium® 4 Processor - M, please visit <http://www.intel.com/ebusiness/mobile>.